Technical Report 734

Bonuses, Wages, Training Costs, and Quit Rates: A Three Stage Least Squares Approach

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report analyzed the impact of Regular Military Compensation (RMC) and Selective Reenlistment Bonuses (SRB) on quit rates and that of quit rates, training costs, and potential civilian wages of soldiers on SRB in a system of three stage least squares regressions. The results reveal that an increase in RMC and SRB reduces quit rates. Also, SRB is being rightly increased with an increase in training costs and civilian wages in both combat and non-combat arms groups of occupations.

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FOREWORD

The Personnel Utilization Technical Area of the Army Research Institute (ARI) performs multidisciplinary research in the areas of soldier family, retention, and readiness. Questions have recently arisen regarding the impact of Regular Military Compensation and Selective Reenlistment Bonuses (SRB) on reducing quit rates, and the determination of SRB. This report addresses these questions and was prepared as part of ARI's continual support for the Office of the Deputy Chief of Staff for Personnel.

This study was sponsored by the Director of Military Personnel Management, Office of the Deputy Chief of Staff for Personnel. A draft report was submitted on 4 February 1987. The next report will deal with the effect of SRB on Military Occupational Specialties and will be delivered in December 1987.

The research presented in this report quantifies several of the economic variables thought to affect retention, and contributes to the ongoing theoretical and empirical discussion of military manpower modeling.

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BONUSES, WAGES, TRAINING COSTS, AND QUIT RATES:
A THREE STAGE LEAST SQUARES APPROACH

EXECUTIVE SUMMARY

Requirements:

The U.S. Army Research Institute (ARI) conducts research on manpower, personnel, training, and family issues of particular significance and interest to the U.S. Army. Questions have been raised about the Army's ability to increase retention of enlisted soldiers in a cost-effective way. The Army faces higher separation or quit rates. The payment of Selective Reenlistment Bonuses (SRB) can mitigate the problem.

Procedure:

The author derives conceptual relationships between the quit rate, SRB, training costs, regular military compensation, and potential civilian wages of soldiers. These relationships are estimated empirically by using a simultaneous system of three stage least squares equations. Separate sets of equations are estimated for soldiers in combat and non-combat arms.

Findings:

The results reveal that an increase of 1% in SRB reduced the quit rate by about 0.2% in combat arms and by about 0.1% in non-combat arms. The equations for SRB revealed that an increase in training costs of 1% was associated with an increase in SRB of 1.64% in combat arms and of 1.71% in non-combat arms. An increase in potential civilian wage of 1% resulted in an increase in SRB of 1.76% and 1.81% in combat and non-combat arms, respectively. The results reveal that an increase in SRB and Regular Military Compensation paid to soldiers tend to reduce their quit rates.

Utilization of Findings:

This research shows that it is cost effective for the Army to increase SRB in order to reduce quit rates. It also reveals that SRB should be increased with increases in training costs and potential civilian wages of soldiers.

BONUSES, WAGES, TRAINING COSTS, AND QUIT RATES:
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A THREE STAGE LEAST SQUARES APPROACH

INTRODUCTION

This paper has a three-fold objective. The first objective is to develop a general conceptual model relating wage differentials to training costs (TRC), quit rates (Q) and opportunity cost of labor. The second objective is to estimate it empirically in a system of three stage least squares (3SLS) regressions by using data for the U.S. Army. The third objective is to reduce aggregation bias in the data by disaggregating Army occupational groups into combat arms and non-combat arms. It is hypothesized that soldiers in combat arms are imparted firm-specific training by the Army, and are, therefore, less readily transferable to civilian sector. Therefore, their supply responds more to wage differential incentives offered by the Army relative to soldiers in non-combat arms who are trained in general skills.

The initial literature on labor turnover (or quits or separations) concentrated on the decision-making on the part of the employees (Stoikov and Raimon, 1968; Burton and Parker, 1967) in different industries. The recent literature on turnover includes employer's utility function but is restricted to wage and training costs and excludes payment of wage differentials or bonuses. For example, Pencavel (1972) noted that a profit-maximizing firm will not set wages independently of Q but will instead, choose a wage-Q mix which is perceived to be optimal, *a priori*. If actual Q increase, the firm responds by increasing wages and if actual wages exceed the optimal, the firm increases layoffs. He demonstrated that wages higher than the optimal wage tended to reduce Q and increase layoff rates. Bloch (1979) argued that the effect of wages on layoff rates was ambiguous. Firms would tend to pay higher wages to trained workers to compensate them for their increased Marginal Value Products (MVPs) resulting form training. Employers would, however, tend to pay lower wages to new employees whose MVPs are lower because they have not yet been trained. Parsons (1977) reviewed five studies that related Q to several explanatory variables and concluded that Q decreased both with an increase in wages and with an increase in such <u>general</u> skill levels as education. Parsons (1973) delineated firm-specific capital into firm-owned and worker-owned components and concluded that the former was negatively related to layoff rates and the latter was negatively related to quit rates. Parsons (1973) further classified firm-owned specific human capital into hiring and training costs and concluded that wages paid should be directly proportional to training costs in order to reduce quit rates. Smith (1979) reviewed the available literature on wage differentials and noted that empirical studies have mostly been inconclusive.

Goldfarb and Hosek (1976) derived steady state equilibrium conditions of profit maximizing firms and demonstrated that these firms recouped their training costs by paying workers less than their MVP. Haber, Lamas and Eargle (1984) extended Goldfarb and Hosek's model by assuming that a group of employees' MVP, Wage Rate and Q were constant through time with a sufficiently long time horizon. They did not, however, estimate their equation econometrically.

An objective of this paper is to extend the Haber-Lamas-Eargle (1984) model to derive profit maximizing conditions of a firm in an interdependent framework of bonuses, TRCs, MVPs and Qs and estimate it econometrically. An empirical verification of the extended model is based on the Army data in the era of the all Volunteer Force during which enlisted soldiers are free to quit or continue at the end of their first term of service. The Army pays them wage differentials, called Selective Reenlistment Bonuses (SRBs), apart from the institutionally fixed military wages called Regular Military Compensation (RMC), as and inducement for reenlistment. This model of relatively fixed wages appears to be generally applicable in such civilian counterparts as the unionized wages that are fixed for the contractual term, with bonuses paid as wage differentials and non-market determined wages paid under the Davis Bacon Act for Federal government contracts. We also estimate opportunity costs to soldiers of staying in the Army, namely, the potential civilian earnings based on the Current Population Survey data. One can hypothesize that a soldier will quit from the Army if his potential civilian earnings exceed the sum of the Regular Military Compensation and the Selective Reenlistment Bonus, ceteris paribus. The training costs incurred by the Army are analyzed in terms of training costs per soldier. The quit rates are for the soldiers who were eligible to reenlist but decided to separate voluntarily at the end of their enlistment terms.

THEORETICAL ANALYSIS OF BONUSES, QUIT RATES, AND TRAINING COSTS

A profit maximizing firm recoups its training costs over the terms of service of the employees (after their training) by paying them less than the MVP. The difference between MVP and the wage rate, discounted to the present, and summed over all periods during which an employee remains in the firm, is the return to the firm on its investment in training. Since an employee may quit from the firm at any time, employers use an expected value of return in which the discounted return in any period is multiplied by the probability that the worker will continue with the firm during the period. Profit is maximized when the number of employees hired at the margin is such that the expected present value of the return from offering training equals the cost of training (TRC). Such an equilibrium condition, as derived by Goldfarb and Hosek (1976), is given by:

$$(1) \qquad \sum_{t=o}^{N} [\,(MVP_t - W_t) / (1 - r)^t]\,(1 - Q_t) - TRC = o$$

where N is the employer's time horizon, MVP_t and W_t are MVP and Wage in time period t, respectively, r is the discount rate, Q_t is an employee's quit rate probability in period t and TRC is training costs. The first squared bracketed term on the left hand side of eq. (1) is the discounted return during period t and $(1 - Q_t)$ is the probability that the discounted return will be realized during the period. The product of these two terms is the expected present value of the return. The firm maximizes profit by hiring workers until the expected present value of the stream of returns is equal to the cost of training additional workers.

The steady state equilibrium condition of a profit maximizing firm is obtained by Haber, Lamas and Eargle (1984) from (1) by assuming (i) that there is a single group of workers, (ii) that an employee's MVP, wage rate and quit rate is constant through time, and (iii) that a firm's time horizon is sufficiently long. It is given by:

$$(2) \quad [(MVP - W)/(r + Q)] - TRC = 0$$

Haber, Lamas and Eargle (1984) indicate that a wage differential (MVP - W) in such a system is the same as Selective Reenlistment Bonus (SRB) paid by the military. While the U.S. Army does not maximize profits, it has the objective of cost minimization, a dual of profit maximization, subject to such constraints as maintenance of a given force structure and it's readiness. Eq. (2) can be extended to derive profit maximizing conditions with variations in stipulations on MVP, Q or TRC but assuming that wages are fixed institutionally so that the only wage differential is a bonus. Rewrite eq. (2) to denote two groups of workers:

(3) $[(MVP_1 - W_1)(1 + r / r + Q_1)] - TRC_1 = 0$

(4) $[(MVP_2 - W_2)(1 + r/r + Q_2)] - TRC_2 = 0$

Assuming that $MVP_1 > MVP_2$ and $TRC_1 > TRC_2$ and multiplying both sides of (3) by $(1 + r/r + Q_1)$ and that of (4) by $(1 + r/r + Q_2)$, we get:

(5) $W_1 = MVP_1 - TRC_1\ (1 + Q_1/1 + r)$

(6) $W_2 = MVP_2 - TRC_2\ (1 + Q/1 + r)$

Subtracting (6) from (5) and assuming that $W_1 > W_2$ and quit rates are equal, $Q_1 = Q_2 = Q$, we get:

$$(7)\ W_1 - W_2 = (MVP_1 - MVP_2) + (TRC_2 - TRC_1)\ [(1 + Q)/(1 + r)]$$

The Left Hand Side of eq. (7) denotes the bonus or the wage differential for group 1. This bonus varies positively with the incremental MVP of group 1 over group 2. Assuming that opportunity cost of a worker reflects the MVP, one can hypothesize that an increase in the opportunity cost should result in an increase in the wage differential or the bonus. Also, when quit rates Q are constant, it is profitable for the firm to hire workers with lower training costs, TRC_2. If, on the otherhand, quit rates vary and TRCs and MVPs are constant, we get:

$$(8)\ W_1 - W_2 = [(TRC/1 + r)]\ (Q_2 - Q_1)$$

so that it is profitable for employers to increase workers with lower quit rate, Q_2. Also (8) shows that, given Q, an increase in the TRC is associated with an increase in bonus, $(W_1 - W_2)$.

It is not possible to derive theoretical equilibrium profit maximizing conditions when there are simultaneous changes in bonuses, TRC, Q and MVPs. In view of the interdependence of these variables, the effect of changes in them on the bonus and quit rates cannot be determined *a priori* but has to be relegated to an empirical analysis. The interdependence of these variables can best be estimated in a system of three Stage Least Squares (3SLS) equations which yields consistent and efficient parameters.

MODEL SPECIFICATIONS

The supply of labor offered to or withdrawn from an employer can be postulated as a function of wage rate and a wage differential or bonus. An increase in wage rate or the bonus would tend to increase the supply of labor or, conversely, would tend to reduce quit rates (Q). The Q can be related to an institutional wage, such as the Regular Military Compensation (RMC) which includes basic pay and allowances for quarters and subsistence. An increase in RMC tends to reduce Qs. Haber-Lamas-Eargle (1984) state that their wage differential model can be applied to the Army for analysis of the Selective Reenlistment Bonuses (SRBs). An increase in SRB would tend to reduce Q. The Army management tends to change SRBs based on demand and supply of soldiers in an Army occupation. Assuming that SRB is an exogeneous variable, we specify the labor supply function as:

$$(9) \quad Q_i = a_o - a_1 \, RMC_i - a_2 \, \ln SRB_i + e_1;$$

where Q_1 = percent Quit Rate in military occupational specialty (MOS)i; RMC = average regular military compensation in MOS_i; ln SRB_i = natural log of average SRB in MOS_i; e_1 = error term in eq. (9).

It may be recalled from eq. (8) that the wage differential SRB was related positively to Training Cost (TR) per soldier, given Q. Moreover, since SRBs are increased by the Army management with increase in Q, we hypothesize:

$$(10)\quad \ln\widehat{SRB}_i = b_o + b_1 \ln TRC + B_2\hat{Q} + e_2;$$

where $\hat{Q}$ is an endogeneous variable from eq. (9) and $\widehat{SRB}$ is an exogeneous variable from the same eq. and e_2 is an error term of eq. (10). We assume an instantaneous and simultaneous relationship of Q and SRB not only because of our assumption of a very short time period but also because of the fact that the Army management tends to change SRB frequently in order to fill the required positions to ensure readiness of the force. Alternatively, one can stipulate that a soldier continues in the Army because he expects to be paid SRB which, together with RMC, reflects a civilian wage (CIVWAGE). Consequently, the Army management should increase SRB with an increase in CIVWAGE in order to retain the soldier. Therefore:

$$(10A)\quad \ln\widehat{SRB} = B_o + B_1 \ln TRC + B_2\hat{Q} + B_3 \ln CIVWAGE + e_3;$$

where $\ln\widehat{SRB}$ is the estimated value of lnSRB estimated in eq. (9) and e_3 is the error term of eq. (10a). The lnSRB is purged of its correlation with RMC so that multicollinearity is not a problem (Smith and Ehrenberg, 1983). The reason for using logarithmic values of SRB, TRC and CIVWAGE is that such a specification gives the best fit for human capital supply functions (Heckman and Polachek, 1974; Pencavel, 1973). The set of eq. (9) and (10) on the other hand and (9) and (10a) on the other will be estimated separately as two systems of simultaneous three Stage Least Squares (3SLS) in order to test the difference made by inclusion of CIVWAGE. An advantage of such a system of 3SLS is that it uses the available information on covariances of the error terms. Therefore, Judge et.al (1982) rightly noted that a system of 3SLS equations is as robust as the Full Information maximum likelihood estimators. In short, a simultaneous system of 3SLS yields consistent and efficient parameters of the system of equations. These parameters would be inconsistent and inefficient in a system of Ordinary Least Squares and consistent but inefficient in a simultaneous system of two Stage Least Squares (2SLS). A disadvantage of 3SLS relative to 2SLS, as rightly pointed out by Hausman (1978: 1264-65), is that: "Under the null hypothesis of correct specification, 3SLS is efficient but yields nonconsistent estimates of all equations if any equation is misspecified. 2SLS is not as efficient as 3SLS, but only the incorrect specified equation is inconsistently estimated if misspecification is present in the system". To test for misspecification in a 3SLS system, Hausman (1978) develops a test statistic based on the difference between covariances of the 3SLS and 2SLS. We will use this statistic to test the null hypothesis of misspecification of both eq. (9) and (10) on the one hand and eq. (9) and (10a) as two separate sets.

A problem with the preceding system of equations is an assumption in eq. (9) that SRB is determined exogeneously to bring about a change in Q. It is possible that the SRB is endogeneous and is itself changed after a change in Q. Grilliches and Interiligator (1983) explain a test statistic based on Hausman (1978) for determining exogeneity in a system of simultaneous equations. Calculation of this test statistic requires estimation of the system of simultaneous equations (9) and (10) with Limited Information (LI) which is given by a two stage least squares and comparing it with Full Information (FI) estimators available from a system of 3SLS. The test statistic is:

$$(11)\ {}^{W}p_i = \hat{q}'\ [\ V\ (d_1\ LI) - V\ (\ d_1\ FI)]\ \hat{q}$$

where ${}^{W}p_i$ is distributed as Chi square with (k_1, $p - p_1$) degrees of freedom. The $\hat{q}'$ in eq. (11) is given by:

$$(12)\ \hat{q}' = d_{FI} - d_{LI}$$

The Right Hand Side of eq. (12) is expressed as:

$$(13)\ \ d_{FI} - d_{LI} = [(X_1{}'P_Z X_1)^{-1} X_1{}'P_Z - (X_1{}'P_Z X_1)^{-1} X_1{}'Pz]\ Y_1$$

where P_Z is an indempotent matrix for LI and P_Z is an indempotent matrix with FI, $Y_1 = s_Z$. We will hypothesize that SRB is exogeneous. We will calculate the value of W_{pi} in eq. (11) and compare it with theoretical Chi-squared value to test for exogeneity of SRB.

The discussion in eq. (9) and (10) assume as if all occupations in the military are homogeneous. Warner and Goldberg (1984) rightly note for the Navy that some occupations, such as Sea Duty requiring long family separations, have relatively higher non-pecurniary cost. For the Army, Combat Arms occupations involve higher non-pecuniary costs such as digging ditches, arduous camping and continuous vigil. Hence, the quit rates in these occupations are likely to be higher.

On the otherhand, civilian demand for these occupations is likely to be lower because their skills are not transferable as easily as that of soldiers in non-combat occupations. Therefore, if we combine all occupations into a single category, there can be an aggregation bias. To avoid such a bias, we estimated the two sets of equations (9)-(10) and (9)-(10a) separately for combat and non-combat arms. The classification of these occupations is based on grouping MOSs into Career Management Fields (CMFs). The CMFs are relatively homogeneous occupations based on similarity of training, job requirements and working conditions. Based on these criteria, it is assumed that soldiers in combat arms acquire "firm-specific" or "Army-specific" human capital and those in non-combat arms obtain "general" human capital. Hence their quit rates would tend to respond at different rates to a given increase in SRB or RMC. The observations in our equations are, however, average values of all the variables in the MOS. The classification of occupations into the two groups is shown in Appendix Table 1. It must be added that a comparison of military occupations with the Bureau of the Census classification of 1960 revealed that 13.4 percent of all enlisted positions had no civilian counterparts and that 80 percent of all enlisted jobs were in occupations that accounted for only slightly over ten percent of the civilian male work force (Wool, 1965: 232). This picture has changed considerably in the last two decades during which there was a remarkable growth in non-combat occupations. A recent study of Quester et.al (1985: 1-13) refers, among others, to crosswalk of matching military jobs in the Dictionary of Occupational Titles which, in turn, is linked with the Standard Occupational Classification codes and with the Census occupational codes. They concluded that "because the number of persons employed varies by occupation, proportions of military relevant titles cannot be translated to proportions of occupational incumbents" (1985: 1-19).

The selection of CMFs in Appendix Table 1, however, reveals that while most of the combat arms occupations are not likely to have civilian counterparts, most of the non-combat arms occupations, such as administration, medicine, band, communications, engineering, maintenance, chemical, and transportation are transferable to civilian sectors. Hence these occupations would tend to be less responsive to SRBs relative to those in combat arms.

POTENTIAL CIVILIAN WAGES OF MILITARY PERSONNEL

In order to estimate potential civilian earnings of Army separatees it is assumed that individuals in comparable civilian and military occupations with similar human capital would tend to earn comparable wages. The comparable occupation groups in civilian and military sectors were determined from a crosswalk of occupational codes shown in Table 1. To determine the earnings of civilian workers, an OLS regression model was postulated as follows:

(14) $\ln E = A_o + A_1 Exp + A_2 Edu + e_i$

TABLE 1 MAJOR CIVILIAN OCCUPATIONAL GROUPS CORRESPONDING TO MAJOR ARMY OCCUPATION GROUPS

Major Army Occupational Group	IDOS[1] One -Digit Sub-group	Major Civilian Occupation[2]	Civilian Sample Size[3]
Combat Arms:	T	Operatives, including transportation equipment operatives (601-715)	4,552
Non-Combat:			
Technical Personnel	G	Technicians (080-085 and 150-173)	528
Craftsmen, Mechanics & Production Workers	P	Craftsmen & Kindred Workers (401-580)	5,161
Clerical Personnel	J	Clerical & Kindred personnel (301-395)	1,826
Service Staff	M	Service workers, excluding private household (901-965)	2,467

Source: 1 Interrated Defense Occupational Structure codes.

2 Bureau of the Census, 1970 Census of Population, Classified Index of Industries and Occupations, 1971, pp. 10-14.

3 Bureau of Labor Statistics, Current Population Survey, March 1982, Unpublished Data.

where

$\ln E$ = natural log of the earnings of full-time, full-year, civilian workers;

Exp = experience, defined as age, minus years of education, minus 6 years;

Edu = years of education;

e_i = error term.

The age variable was restricted to 18-32 years and was exclusive of individuals with only an elementary school education as well as college graduates because the enlisted soldiers comprise of less than one percent of these exclusionary categories. College graduates were excluded from the sample (even through many veterans quit to go to college) because their earnings were considerably higher than those of separatees who were mostly high school graduates. Inclusion of college graduates in the civilian sample would have resulted in an upward bias in the sample earnings. The data on earnings, age, and education of the civilian labor force pertained to 1981 and were obtained from the March 1982 Current Population Survey for full-time, full- year, male civilian workers. Civilian wages were estimated only for male workers because this analysis of the Army separatees is restricted to male soldiers. The labor force for the five occupational groups is shown in Table 1.

The regression model was estimated separately for the five occupational groupings. It is, of course, assumed that these occupations are comparable in both the sectors. It is recognized that a finer disaggregation of these groups can reveal considerable incomparability of these occupations, as rightly noted by Wool (1965) and Quester et.al. (1985). There are however, no earnings

TABLE 2. OLS REGRESSION RESULTS FOR EARNINGS EQUATIONS FOR CIVILIAN OCCUPATIONS CORRESPONDING TO ARMY OCCUPATIONS

Occupation	Intercept	Exp.	Edu.	R^2 (Adjusted)
Combat Arms	8.48*	.029*	.064*	.09
	(.116)	(.004)	(.008)	
Technical	8.83*	.05*	.03**	.23
	(.312)	(.013)	(.02)	
Craftsmen, Mechanics	8.51*	.03*	.06*	.09
& Production Workers	(.14)	(.005)	(.01)	
Clerical	8.44*	.03*	.06*	.11
	(.22)	(.008)	(.01)	
Service Staff	7.73*	.04*	.09*	.13
	(.21)	(.008)	(.01)	

(Standard errors are in parentheses)

* Significant at the 0.01 level.

** Significant at the 0.05 level.

Exp. = Experience

Edu. = Education

data available from any other source of data. The results, shown in Table 2, reveals that all coefficients have the expected positive signs and all, except one, are statistically significant at the 0.01 level. In all of the equations, except that for the Technical Occupations, the returns to education are grater than the returns to experience, because of the younger age cohort. The percentage of variation in earning (R^2) explained by experience and education are low (between 10 and 23 percent) because of the cross sectional data as well as the homogeneity of population resulting from excluding (i) women, (ii) older persons, (iii) both highly educated and less educated individuals, and (iv) high paying managerial and professional occupations.

The coefficients of these equations, together with education and experience of individual soldiers, were used to impute civilian wages of separating Army personnel. The estimated civilian wages (CIVWAGE) reported in Table 3 are simple averages of the earnings based on education and experience of individual soldiers in each MOS, aggregated and averaged over the two major Army occupational groups. While the mean civilian wages in each group are not significantly different, the non-combat groups has the expected higher dispersion relative to the combat group.

DATA DEVELOPMENT

Although this model is couched in terms of quit rates, it is necessary to discuss continuation rates from which the quit rates are derived. A continuation occurs when a serviceman is a specific MOS remains in the Army between two points in time, defined to be one year apart. A continuation was determined for individual soldiers on the verge of deciding to reenlist or quit from the Army.

TABLE 3 DESCRIPTIVE STATISTICS FOR COMBAT VERSUS NON-COMBAT OCCUPATIONAL GROUPS

	Combat			Non-Combat		
Variable (Unit)	Mean	Min.	Max.	Mean	Min.	Max.
Civ. Wage (th. $/year)	14.7	11.2	21.2	14.1	7.6	21.3
RMC (th. $/year)	15.3	11.9	18.9	15.1	11.9	18.9
SRB (th. $, lump sum)	3.3	0.1	10.5	2.8	0.1	16.0
Q (% total soldiers, 10-1-80)	24.7	7.4	54.1	23.4	19.0	69.0
TRC (th. $)	19.8	10.6	60.6	20.8	6.6	69.3

Note: RMC = Regular Military Compensation

SRB = Selective Reenlistment Bonus

Q = Quit Rate

TRC = Training Cost per soldier

The continuation rate in a MOS(CRMOS) is computed as:

(15) CRMOS = continuations in the same MOS/(Continuations + Noncontinuations)

where the numerator includes all the servicemen who continued at the end of FY 1981 and the denominator includes all soldiers eligible to reenlist or continue in that occupation at the beginning of FY 1981.

The quit rate, Q, is computed by simply subtracting CRMOS from one. The Q, thus defined, is analogous to the definition of turnover in the civilian sector. The data required to compute Q were developed from Defense Manpower Data Center's (DMDC) Enlistment Master File for FY 1980 and FY 1981. The over 300 MOSs in these files were grouped into 6 Career Management Fields (CMFs) in the combat arms group and 19 CMFs in the non-combat arms group for soldiers who were eligible to reenlist and decided to either quit or reenlist. It must be added that the CMFs were used only for classification of MOSs into combat and non-combat occupations. The observations for the equations, as noted earlier, were the average values of the MOSs. The two occupational groups were based on a comparison of the Department of Defense, Military-Civilian Occupational Source Book, 1983. Only male servicemen were selected since women are excluded from the combat arms. The number of observations varied according to the number of MOS within a CMF (e.g. CMF 11 for Infantry included 11R, 11C, 11H and 11X) as well as by length of service categories which varied from 2 to 6 years. The average quit rate, by MOS and length of service, was used as an observation. Most of the length-of-service observations were, however, for three- and four-year period. Descriptive statistics of quit rates are shown in Table 3.

The Selective Reenlistment Bonus (SRB) paid by the Army is based on a product of: (i) years of reenlistment contract signed by the soldier, (ii) his monthly base pay, and (iii) a multiplier, varying from 1 to 6 according to the degree of requirements of the MOS. An increase in demand relative to supply of servicemen in an occupation results in an increase in the value of the multiplier. These changes are made frequently, almost bi-monthly. The maximum SRB amount in FY 1981 was set at $16,000 institutionally. The SRB values were estimated for soldiers that were eligible to reenlist. These values were estimated by determining decisions of individual soldiers who decided to reenlist or separate from the Army. Such a decision was obtained from the end of term of service (ETS) codes of the soldiers. The ETS provide information on years of reenlistment which was multiplied by his monthly basic pay and the multiplier for his MOS. An average SRB, by MOS, was obtained by simply dividing the sum of SRBs by the number of soldiers who reenlisted. For separatees, it was assumed that they would have reenlisted for an average term of service signed by the reenlistees in their MOS. In short, the average value of SRB for separatees was based on average reenlistment period in an occupation. It was necessary to impute the SRB values for separatees because they were eligible to reenlist and hence could have earned the bonus. Exclusion of SRBs for separatees would have generated a biased sample. It must be noted that most of the separatees had only 3 to 6 years of service. Descriptive statistics of SRBs are reported in Table 3. From this Table, it is observed that the mean of SRB for combat arms is greater than the mean for non-combat arms because the average Q is higher (24.7 percent) for combat arms and hence the Army management specifies higher values of SRB multipliers for these occupations. While the mean of non-combat arms is lower, its variance is higher because its multipliers vary considerably, from 1 to 6 whereas that of combat arms varied between 2 and 4.

The Training Cost (TRC) refers to the cost of Advanced Individual Training which varies by occupation and lasts from a few weeks to a year. Data tapes from the Army Finance and Accounting Center (1983) were used to obtain average cost data by MOS and were matched and merged with the file on SRBs, Q, CIVWAGE, and RMCs, by MOS number. The training cost data include only the costs of formal training courses and exclude the costs of on-the-job training. The cost components in this variable are comprised of such elements as (i) military pay and allowances for students, faculty, and training support activity personnel, (ii) ammunition expended in training, and (iii) the annual replacement cost of equipment. These costs are, however, conservative estimates since they exclude the costs of such benefits as medical, retirement and the GI Bill (post-separation costs paid by the Army) as well as annualized values of construction costs of structures. Comparison of average TRC with average values of SRBs, by the two occupational groups, indicate that it is cost-effective for the Army to pay SRBs rather than let a soldier separate, replace him by recruiting an untrained soldier and incur the higher recruitment and training costs. For instance, the average cost of training a soldier is $48,500 (Lakhani, et.al., 1986) compared to the average cost of SRB at $3,000 per soldier.

Regular Military Compensation (RMC) was estimated by adding quarters and subsistence allowances to base pay and adjusting for the federal tax advantage, given the information on marital status, pay grade and length of service of first term soldiers. As in the case of SRBs, RMC was initially estimated for individual soldiers given his pay grade and length of service. An average RMC, by MOS, was then estimated by simply dividing the sum of individual RMCs by the total number of soldiers in that sample for the MOS. Hence the observation for the equation is per soldier RMC, by MOS. The descriptive values of RMC are also shown in Table 3.

Civilian wages were imputed from the values of the coefficients of the OLS equations in the civilian wage model and the information on values of experience and education of the military personnel. As such, these wages denote wages of soldiers as if they were civilians. The descriptive statistics of civilian wage variables are also shown in Table 3 and represent average values by MOS.

RESULTS

Table 4 shows the results of the 3SLS regressions specified in eq. (9) -(10) and (9) - (10a) for combat and non-combat arms. The coefficient for SRB in eq. (9) reveals that an increase in SRB tends to reduce quit rates in both the groups of occupations. Between the two groups, however, the reduction in quit rate is smaller (0.08 percent) for the non-combat group for a one percent increase in SRB. Since the average SRBs in the two groups are almost equal (see Table 3), one can infer that soldiers with "general" human capital in non-combat arms tend to be influenced relatively less by a given increase in SRBs than soldiers with "firm-specific" human capital. The coefficient for RMC is negative, as expected, for both occupational groups. The value of the RMC coefficient is also smaller for the non-combat occupations. Since the average RMC in both the groups is almost equal (see Table 3), one can reconfirm that soldiers with "general" human capital tend to be influenced less by pay than those with "firm-specific" human capital.

Eq. (10) of Table 4 shows that, as expected, an increase in TRC results in an increase in SRB. Therefore, the Army management is rightly increasing the SRBs in a cost-effective manner. The coefficients for the combat and non-combat groups indicate that a one percent increase in TRC results in a 1.64 percent increase in SRBs in combat-arms and 1.71 percent increase in SRBs in non-combat arms. This is as expected since Q respond relatively less to SRBs in non-combat arms groups of occupations.

Eq. (9) - (10A) in Table 4 test the hypotheses by including CIVWAGE in eq. (10A). The results for eq. (9) in this set are comparable with those of eq. (9) in the preceding set. Eq. (10A) reveals that an increase in CIVWAGE results in an increase in SRB in both occupational groups. The increase in SRB is, as expected, slightly higher at 1.81 percent in non-combat group compared to 1.76 percent increase in SRB in combat arms for every one percent increase in CIVWAGE.

The preceding two sets of 3SLS equations as well as their corresponding sets of 2SLS equations (not shown for brevity) were also tested for heteroscedasticity by estimating the Durbin Watson statistic. Its value exceeded the critical value of two and did not lie in an indeterminate range so that it was inferred that serial correlation was not a problem.

A test of misspecification of the model was undertaken by using Hausman's (1978: 1266) method. This involved estimating $\hat{B}_{3SL}$ and $\hat{B}_{2SLS}$, taking their difference, $(\hat{q})$ and comparing the difference with their weighted difference, given by $M(\hat{q}) = M(\hat{B}_{3SLS}) - M(\hat{B}_{2SLS})$, where M is variance of the parameters.

TABLE 4. 3SLS RESULTS FOR QUIT RATES, BONUSES, WAGES, AND TRAINING COSTS IN COMBAT AND NON-COMBAT OCCUPATIONS
(t ratios are in parentheses)

Eq.	Statistic/Variable	Combat		Non-Combat	
9	Dependent Variable:	QUITRATE		QUITRATE	
	Explanatory Variable:				
	lnSRB	-.20*	(1.86)	-.08*	(2.20)
	lnRMC	-6.31*	(11.33)	-5.16*	(25.47)
	Intercept	55.05*	(11.16)	42.72*	(23.10)
	N	371		1,158	
10	Dependent Variable:	lnSRB		lnSRB	
	Explanatory Variable:				
	QUITRATE	.16*	(5.63)	.14*	(7.13)
	lnTRC	1.64*	(31.06)	1.71*	(61.12)
	Intercept	-5.43*	(14.25)	-6.28*	(27.89)
	N	371		1,158	
9	Dependent Variable:	QUITRATE		QUITRATE	
	Explanatory Variable:				
	lnSRB	-.22*	(2.14)	-.12*	(3.55)
	lnRMC	-6.24*	(11.25)	-5.07*	(25.05)
	Intercept	54.63*	(11.67)	42.18*	(22.72)
10a	Dependent Variable:	lnSRB		lnSRB	
	Explanatory Variable:				
	QUITRATE	0.40*	(9.39)	.50*	(18.62)
	lnTRC	1.65*	(29.43)	1.77*	(63.23)
	lnCIVWAGE	1.76*	(10.43)	1.81*	(26.58)
	Intercept	-20.60*	(12.96)	-21.42*	(33.54)
	N	371		1,158	

* Significant at the 0.01 level
SRB = Selective Reenlistment Bonus
CIVWAGE = Civilian Wage
TRC = Training Cost per soldier

Hausman (1978) shows that the resulting statistic is distributed as a Chi-square. The calculated value of this statistic in eq. (9) and (10) for the combat arms system was 5.05 with two degrees of freedom and the corresponding theoretical value at the 1 percent significant level was 9.21. It was therefore, concluded that there was no misspecification. Similarly, for eq. (9) and (10) in the non-combat group, the calculated value was 1.21 compared to the critical value of 9.21 so that it was concluded that there was no misspecification. The calculated Chi-squared values for eq. (9) and (10A) for combat and non-combat were respectively 1.43 E-22 and 1.06 E-24 with theoretical vale of 9.21. Hence it was concluded that there was no misspecification of this set of equation as well.

The test of exogeneity of SRB was constructed by estimating eq. (11). The null hypothesis was that SRB was exogeneous. The calculated value of the statistic "W" for the combat-arms Q equation was 3.61. The critical value of the Chi-squared distribution with 2 degrees of freedom at the 1 percent significance level was 9.21 so that we failed to reject the hypothesis that SRB was exogeneous. Similarly, for the non-combat system, the calculated value of W was 0.04 and the critical value was 9.21 so that we failed to reject the hypothesis that SRB was exogeneous. The calculated Chi-squared values for the set of eqs. (9) and (10A) for combat and non-combat were respectively 3.88 and 0.05. Since the theoretical value was unchanged at 9.21, it was concluded that SRB was exogeneous in this second set of equations as well.

CONCLUSIONS

This paper developed a general conceptual model of wage differentials, quit rates, training costs and opportunity cost of wages in an alternative sector and verified it empirically by using data for the U.S. Army. The conceptual model revealed that quit rates decreased with an increase in wage differentials, holding training costs constant; and wage differentials increased with an increase in training costs, holding quit rates constant. The Army data included Selective Reenlistment Bonuses (SRBs) for wage differentials, Regular Military Compensation, wage, if civilian, for the alternative wage and training cost per soldier. The potential civilian wages of soldiers were estimated from the current population surveys. To avoid aggregation bias, the model classified Army occupations into combat and non-combat arms. It was hypothesized that the decrease in quit rates associated with a given SRB or RMC would be smaller in non-combat arms relative to that in combat arms because of its "general" human capital compared to the "firm-specific" human capital in combat arms. Empirical verification of the model was based on estimation of a system of three stage least squares equations. The results revealed that an increase in SRB by 1 percent reduced quit rates in combat arms by 0.20 and 0.22 percent but similar increase in SRB in non-combat arms reduced quit rates by only half as much, between 0.08 and 0.12 percent. The quit rates associated with a one percent increase in RMC were also smaller in the non-combat relative to combat arms groups. The equations for SRB revealed that an increase in training costs by 1 percent resulted in an increase in SRB by 1.64 percent in combat arms and by 1.71 percent in non-combat arms.

Hence the Army is rightly increasing SRBs in concert with an increase in training costs which were higher in non-combat arms. An increase in civilian wage by 1 percent resulted in an increase in SRB by 1.76 percent in combat arms and by 1.81 percent in non-combat arms. This is also as expected because non-combat arms occupations are endowed with "general" human capital, with smaller quit rates response to SRBs and hence the greater need to increase their SRBs.

APPENDIX TABLE 1. Classification of Army Combat and Non-Combat Arms Occupations

Non-Combat Arms (General Human Capital) CMF	Description	Combat Arms (Specific Human Capital) CMF	Description
71	Administration	11	Infantry
91	Medicine	13	Field Artillery
97	Band	16	Air Defense Artillery
31	Communication Electronics	96	Military Intelligence
98	Electronic Warfare	19	Armor
12	Combat Engineering	55	Ammunition
27	Land Combat/Air Defense Maintenance		
23	Air Defense Systems		
29	Communication Electronic Systems		
28	Aviation Communication		
31	Communication Electronics Operator		
81	Topographic Maintenance		
63	Mechanical Maintenance		
76	Supply and Service		
51	General Engineering		
54	Chemical		
64	Transportation		
67	Aircraft Maintenance		
84	Public Affairs		

CMF = Career Management Field

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